

## **THE SOUTHWEST WASHINGTON COASTAL EROSION STUDY: RESEARCH SUPPORTING COASTAL MANAGEMENT**

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### **Introduction**

The Southwest Washington Coastal Erosion Study, now in its third year, is a five-year multi-disciplinary investigation of a 165-km long coastal region between Tillamook Head, Oregon and Point Grenville, Washington. The Study is sponsored by the USGS Coastal and Marine Geology Program and the Washington Department of Ecology Coastal Monitoring & Analysis Program. Since 1993, several coastal erosion crises have occurred, and more than \$30 million have been spent on coastal protection works, while other multi-million dollar coastal projects are being planned. These crises have identified the fact that federal, state, and local agencies lacked basic data and information needed for decision-making on project engineering, resource management, and hazard mitigation. Results of this Study are now being used by state and local governments to aid in mitigating existing erosion problems, as well as in long-term planning for future coastal development.

### **Background**

In 1994, erosion along the southwest coast of Washington State came to the forefront of attention of the public and governmental agencies. A shoreline breach adjacent to the Grays Harbor South Jetty in December 1993 quickly developed into a serious erosion problem for the community of Westport. Within two years, critical erosion problems also occurred at Fort Canby, North Cove, Ocean Shores, and Connor Creek, threatening community infrastructure, resource-based industries, public access, and public and private property (Figure 1). Emergency remedial measures at any of these erosion hot spots was recognized to be expensive, potentially costing several million dollars for a single project, even as temporary solutions having uncertain life expectancies and consequences. Assessing the cause of these erosion problems and what should be done to manage erosion over the long term seemed ominous at the state and local level. Most of the data and information on the coast was confined to the Columbia River and Grays Harbor entrances, where the US Army Corps of Engineers maintained navigation projects. In addition, the placement of many large dams throughout the Columbia River basin since the late 1930s lead to the speculation that the sand supply to the coast had been greatly diminished, but it was unclear when, if, and how the coast would be affected.

### **Cooperative Program Development and Implementation**

In Autumn 1994, the Department of Ecology (Ecology) organized a series of meetings with local, state and federal agencies to determine how to develop better information on the coastal processes of the region. A consensus of needs was developed which formed a "Banner Proposal" for a cooperative interagency program to investigate the natural hazards and coastal changes along the southwest Washington coast. The Banner Proposal identified the motivation, justification, organizational framework, and benefits for a collaborative initiative aimed at building a scientific foundation for coastal management and decision-making. The overall intention of this effort was to develop a partnership to enhance the collective knowledge of fundamental coastal sediment dynamics in order to reduce increasingly costly problems and losses for the southwest Washington coast.

Consequently, Ecology and local communities were particularly moved to request the assistance of the USGS Coastal and Marine Geology Program to become involved in this regional Study as a lead participant. The role of the USGS as the Nation's earth science information agency, and its experience with regional coastal erosion studies, made the organization uniquely suited to address the comprehensive needs of this Study. In particular, the oceanographic and geological expertise of the USGS would enable the building of a geological and coastal processes framework to provide the essential regional context and longer-term perspective of the rapidly changing coast. The ability of the USGS to address the spectrum of temporal and spatial scales of coastal change, including both the natural and anthropogenic influences, was also of great relevance. Finally, the Coastal and Marine Geology Program approach to working with state

partners as both a client and a scientific cooperator was very attractive to Washington State agencies and local communities.

In March 1996, the USGS and Ecology sponsored a workshop convening coastal scientists and engineers to assess the state of the knowledge and formulate hypotheses (Gelfenbaum *et al.*, 1997). By May 1996, both agencies had received funding to begin the Southwest Washington Coastal Erosion Study, in partnership with local governments and other state and federal agencies. The USGS and Ecology took the lead on developing the cooperative program scope and study plan. The scope was designed to allow federal, state, and local agencies to contribute resources and capabilities where they were most effectively applied. The USGS and their funded collaborators became responsible for investigating sediment budgets, framework geology, and inner continental shelf processes, and for integrating the oceanographic and geologic research elements. Ecology was designated to investigate shoreline change and beach morphology, manage the project databases, and serve as the link between federal and local efforts, developing decision-support products, and assisting in outreach efforts. Local communities identified the need to undertake site-specific studies and projects as well as present regionally-based educational programs and engage in long-term planning in collaboration with the state and federal agencies.

The study approach has been designed to investigate this coastal region from a systems perspective and include assessments of the relative influences of the sediment budget, regional tectonics, climatic forcing, and human intervention on the evolution of the coast. The primary goals of the study are to: understand regional sediment system dynamics; determine natural and anthropogenic influences on the littoral system; and predict coastal behaviour at a management scale (*i.e.* decades and tens of kilometers). The Study tasks include: an assessment of previous studies; establishing a geodetic control network; investigating the evolutionary sequences of the coastal barriers; analyzing historical shoreline and bathymetric change; determining the sediment budget for the littoral system; mapping the inner shelf and Holocene stratigraphy; monitoring active beach and shoreface processes; conducting shoreline change modeling; developing a project database; and providing outreach and educational information. An overview of the study and initial results are presented in Kaminsky *et al.* (1997).

### **Study Results and Products**

The Study has developed a geological framework (*e.g.* Wolf *et al.*, 1998; Woxell, 1998) and a historical base of information to initiate quantitative modeling of coastal change at a variety of scales (Kaminsky *et al.*, 1999). A morphology monitoring program has been established and short-term beach changes have been documented (Ruggiero *et al.*, 1998, 1999). A few of the important scientific questions being addressed (Gelfenbaum *et al.*, 1999) include:

- Are Grays Harbor and Willapa Bay presently accumulating Columbia River sediment or have they reached equilibrium?
- Is the inner shelf still accumulating Columbia River sediment as it has in the past, or is it stable, or perhaps a source to another sedimentary environment in the Columbia River littoral cell?
- How much of the dredged material disposed near the mouth of the Columbia River is available to the littoral cell?
- Has the supply of sediment from the Columbia River stabilized, and how long does it take the littoral system to adjust to changes in supply?

The science and products developed through the Southwest Washington Coastal Erosion Study will serve as a basis for improved coastal management and policy at the local and state level. The preliminary results of the monitoring data, shoreline change analysis, and modeling efforts are supporting the City of Ocean Shores in developing a long-term alternative to erosion problems. Study staff have been involved with advisory committees, public workshops, and local conferences and educational events. Public education materials have been produced, including a video (Wessel *et al.*, 1998), a glossary of terminology (Voigt, 1998), brochures, and an internet home page. The Study is continuing to produce public information and facilitate the transfer of knowledge and integration with the decision-making process of coastal managers (Voigt, 1998).

## References

- Gelfenbaum, G., Kaminsky, G.M., Sherwood, C.R., and Peterson, C.D., 1997. *Southwest Washington Coastal Erosion Workshop Report*, USGS Open File Report 97-471, 101p.
- Gelfenbaum, G., Sherwood, C.R., Peterson, C.D., Kaminsky, G., Buijsman, M., Twitchell, D., Ruggiero, P., Gibbs, A., and Reed, C., 1999. The Columbia River Littoral Cell: A Sediment Budget Overview, *Proceedings of Coastal Sediments 99*, ASCE, Long Island, NY.
- Kaminsky, G.M., Buijsman, M., Gelfenbaum, G., Ruggiero, P., Jol, H.M., Gibbs, A.E., and Peterson, C.D., 1999. Synthesizing Geological Observations and Processes-response Data for Modeling Coastal Change at Management Scale, *Proceedings of Coastal Sediments 99*, ASCE, Long Island, NY.
- Kaminsky, G.M., Ruggiero, P., Gelfenbaum, G., and Peterson, C. 1997. Long term Coastal Evolution and Regional Dynamics of a US Pacific Northwest Littoral Cell, *Proceedings of Coastal Dynamics '97*, pp. 614-623.
- Ruggiero, P., Cote, J., Kaminsky, G., Gelfenbaum, G., 1999. Scales of Variability along the Columbia River Littoral Cell, *Proceedings of Coastal Sediments 99*, ASCE, Long Island, NY.
- Ruggiero, P., Kaminsky, G., and Plant, N.G., 1998. Coastal Morphologic Variability of High Energy Dissipative Beaches, *Proceedings of the 26<sup>th</sup> International Conference on Coastal Engineering*, Copenhagen, DK.
- Voigt, B. 1998. Merging Coastal Research and Policy for Improved Coastal Hazard Management, *Proceedings of the 16<sup>th</sup> International Conference of The Coastal Society*, Williamsburg, Virginia, p. 160a.
- Voigt, B. 1998. *Glossary of Coastal Terminology*, Washington State Department of Ecology, Coastal Monitoring & Analysis Program, Publication No. 98-105, 89p.
- Wessels, S.M., Gelfenbaum, G., and Kaminsky, G., 1998. *At Ocean's Edge: Coastal Change in Southwest Washington*, Washington State Department of Ecology, Coastal Monitoring & Analysis Program, Publication No. 98-116, video, 23 min.
- Wolf, S.C., Hamer, M.R., McCrory, P.A., 1997. *Quaternary Geologic Investigations of the Continental Shelf Offshore Southern Washington and Northern Oregon*, USGS Open File Report 97-67.
- Woxell, L.K. 1998. *Prehistoric Beach Accretion Rates and Long-term Response to Sediment Depletion in the Columbia River Littoral System, USA*, M.S. Thesis, Portland State University, Portland, Oregon, 206p.

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